Recommendation on Space-Based Solar Power

The Space Enterprise Council of the U.S. Chamber of Commerce supports the National Security Space Office recommendation of a research program addressing space-based solar power, to explore whether or not this potential energy source could enhance commerce and security. The importance of alternative energy research is becoming increasingly clear, given the urgency of the national and global need for energy that is inexhaustible, affordable, and environmentally clean. Assuring access to energy is particularly relevant to U.S. national security, not only for supply of reliable power to deployed forces but also for avoiding international conflicts that might arise because of energy shortages.

Definition: The concept of space-based solar power (SBSP) involves generation of electricity from solar power in space and transmitting it to Earth. The most frequently referenced architecture would include satellites orbiting the Earth in geosynchronous or other Earth orbits. SBSP satellites would be exposed to intense sunlight 24 hours per day (except for twice-yearly equinox periods, with eclipses less than 70 minutes per day). Such satellites would wirelessly transmit power continuously to fixed locations on the Earth's surface. Power would be transmitted to large but low-density antenna arrays, which would allow for safe and productive uses of the surface area beneath the antennas, such as agriculture. There are a variety of other options for energy from space (e.g., optical power transfer) that may also warrant research consideration.

Potential Benefits: SBSP is unusual among renewable energy options because it might satisfy all four of the following criteria critical to investment decisions: environmental cleanliness, sustainability of supply, flexibility of location, and capacity to generate continuous rather than intermittent power. The cost of SBSP-generated electricity would initially be greater than that provided by fossil fuel or nuclear power but could be comparable to other alternative energy sources, particularly for baseload power. In addition, SBSP might offer an attractive approach, not only for satisfying today's needs but also for meeting tomorrow's much greater requirements. We cannot accurately predict environmental and other consequences of harvesting energy from natural Earthbound sources (e.g., wind, ocean current, geothermal, biofuels), when these methods are scaled up to considerably higher levels. By providing an additional source of renewable energy, SBSP might help avoid potentially negative consequences if limits to the cost-effective expansion of other renewable sources become evident. Beyond enhancement of energy production per se, SBSP might help create new economic opportunities through resultant technology advances in space launch, space utilization, and technological spin-offs applicable to a host of materials and processes. For example, SBSP research might lead to improvements in the efficiency of solar cells that power communications satellites, as well as power management systems for terrestrial solar power systems. Also, to the extent that SBSP is integrated into terrestrial solar power production, development of SBSP ground infrastructure might generate revenue even before deployment of systems in space. In this and related applications, SBSP could emerge as an enhancement for, rather than a competitor with, terrestrial solar power generation.

Necessity of Investment in Research: The Space Enterprise Council (SEC) recognizes that Federal resources are stretched thin and that the nation's budget deficit must be reduced. We maintain, however, that the urgency of energy needs requires ongoing Federal investment in a balanced portfolio of alternative energy research programs, which should include study of SBSP. Major technical progress already achieved in SBSP-related technologies strengthens the case for including SBSP in the mix of alternative sources to explore.

Incremental Research Approach: SBSP should be addressed through an incremental roadmap approach, involving both Government and private sector investment. This roadmap should be constructed to address at the outset key questions about SBSP, including technical viability and cost-effectiveness. The roadmap should consist of a series of milestones, each built on the availability of information generated by prior research. If research results are positive, each milestone should lead to increased government and private sector effort and investment. If justified by research findings, a move from research to demonstration projects should be initiated. Beyond this, milestones should be designed to maximize opportunities for multiple applications of research results, so that improvements in existing technologies and development of new ones could have near-term applications in addition to SBSP (e.g., communications satellite power supplies, terrestrial solar power generation).

Major Factors to Consider:

- Programmatic – The SEC supports the 2007 National Security Space Office (NSSO) recommendation that the Department of Defense carry out a formal funded research study addressing SBSP issues, involving NSSO and the U.S. Air Force as appropriate.
- Economic – Like any other economic activity, the most relevant question is not whether SBSP is profitable in some general sense. The question is whether or not there are any particular contexts in which SBSP might be cost-effective. Examples of potential applications to evaluate might include: (1) broadcast to existing energy distribution grids to provide supplementary surge capacity; (2) the use of continuous SBSP energy in an overall mix with intermittent energy sources; (3) specialized industrial applications, such as synfuel production and remote location resource extraction (e.g., shale oil, tar sands, offshore platforms); (4) high-priority government activities, such as military or disaster relief operations; (5) provision of power to developing nations, with large geographic areas that lack traditional terrestrially-based infrastructure for power production and distribution; (6) space-to-space energy transmission to power orbiting satellites; (7) illumination using optical power transfer; and (8) power provision from space to high-altitude atmospheric vehicles.
- Technical – It will be important to identify the areas where research funding might have the greatest positive impact, by answering critical questions and retiring the most important risks, so that any investment can be strategically targeted. Areas to address might include, but are not limited to, the following: (1) highly-efficient electronic devices (e.g., to convert sunlight effectively into energy in space); (2) precisely controllable wireless power transmission (i.e., to send power effectively from space to Earth's surface); (3) lower-cost space systems and operations (i.e., to assemble power system equipment in space); (4) lower-cost space transportation (i.e., to deliver necessary materials from Earth to space and potentially enable activities beyond Earth orbit); (5) optical power transfer to avoid energy conversion losses on the spacecraft ; and (6) assurance of the safety of all processes (e.g., that the transmission of power from space to Earth will not pose any health or environmental risks).

- Legal/Regulatory – The issues associated with securing spectrum allocation for SBSP power beaming, as well as other legal/regulatory matters (e.g., safety, environment), will need to be identified and addressed.
- Political – It is advisable to move forward incrementally in ensuring that stakeholders are well informed and can begin to factor SBSP research results into their thinking about alternatives for investment of resources.
- International – Careful consideration should be given to cooperation with international industrial and governmental partners, as a means of accessing sufficient resources for SBSP evaluation. Furthermore, assurance of peaceful long-term use of SBSP may be best achieved through collaborative effort. Once a solid technical and policy base has been established through cooperative efforts, international commercial competition may be an important factor in achieving maximum cost-effectiveness.

Conclusion: The appropriate policy question is: "Should the U.S. Government invest in SBSP research, as part of a diversified portfolio of renewable energy programs, including consideration of new approaches that may not have been previously studied?" Our answer to that question is yes. We must explore all potentially significant sources of sustainable energy that might contribute, even if only to a limited extent in the near term, to assurance of security and prosperity. Facing this challenge represents a responsibility not only to our own nation but also to the global community in which we live.